

line. The mesodermic cells are nourished at the expense of the nutritive yolk which surrounds them; they develop in the typical mesenchymatous fashion, and the cavities which arise between them to form the vascular canals are at their commencement little confluent lacunæ of irregular outline. None of these cavities can be considered as corresponding, whether in its mode of development or its origin, to the mesodermal zoonites of the Annelids.

The blastoderm provides for these different proliferations without losing the appearance of a simple epithelial layer surrounding the nutritive yolk; it retains this condition after the rudiments of the mesoderm with those of the endoderm have arisen at its expense and separated from it; it then represents the ectoderm.—*Comptes Rendus*, tome exii. no. 25 (22 juin, 1891), pp. 1460-1462.

*On the Development of the Mesoderm of Crustacea, and on that of the Organs derived from it.* By M. LOUIS ROULE.

I have shown in a former note (June 1891)\*, on the basis of the embryonic stages of *Porcellio scaber*, Latr., the process of the formation of the endoderm; the layer is produced from a pair of rudiments arising from two symmetrical regions of the anterior portion of the blastoderm. The mesoderm also has the same origin, with this difference, however, that the mode of development is much less regular.

My observations have been conducted upon *Porcellio scaber* and *Palæmon serratus*, Fabr. At the moment when the cells of the blastoderm are multiplying in the median ventral line for the production of the nervous centres, and on the sides of the anterior extremity of the body to give rise to the rudiments of the endoderm, two new zones of proliferation appear, one on either side of the ventral nervous band. The different regions of each zone are not perfectly similar; some, separated by equal distances, are thicker than others, and raise up the blastoderm which covers them and from which they have arisen; these elevated spots are the rudiments of the limbs. The blastoderm left at the periphery will become the ectoderm of these appendages, the central mass of cells represents the mesoderm; the cells of this mass become transformed into muscle-fibres in the way which I have described in a previous note ('*Comptes Rendus*,' January 1891).

An analogous multiplication of cells takes place throughout the entire blastoderm, except in those regions which furnish the rudiments of the nerve-centres and of the endoderm, only the process is less vigorous; its effect is to produce the elements which penetrate into the yolk lying beneath the blastoderm, and destroy it little by little by feeding upon the nutritive materials which it contains. These elements correspond to the *vitelline cells* of authors, as to which opinions have been so numerous and so contradictory; they all arise from the blastoderm alone, and are destined to form the mesoderm of the body, without there being any differences of development between them or ground for distinguishing between a primary and secondary mesoderm. Receiving their proper situation

\* *Vide supra*.

in the body of the embryo, these cells are placed between the blastoderm and the endoderm; they multiply by karyokinesis, just like those of the limbs.

The middle layer is now constituted. The elements arise from the blastoderm, which, after having provided for their genesis, persists as the ectoderm on the surface of the body. Moreover, its cells are distributed throughout the entire embryo between the blastoderm and endoderm, are immersed in the deutoplasm, which they devour little by little, and are accumulated in large numbers in the rudiments of the feet.

The mesoderm will next develop in the mesenchymatous fashion. The mass of cells placed in each budding foot commences by acquiring a central cavity, or sometimes two or three adjoining one another; the cells which surround this cavity separate from their neighbours and become free in its interior. The whole of the elements of the mass gradually become involved in this process of dissociation; they increase in length, collect into bands crossing one another in different directions, and become transformed into muscle-fibres. The result is the production, in the space limited by the ectoderm of the limb, of a plexus of mesodermic elements; the meshes of this plexus are spaces filled with a liquid containing a few cells which have not undergone transformation, and which become the vascular sinuses of the appendage; the plasma which fills them and its cells represent the nutritive fluid. The fact that a little central cavity is primitively present in each young appendage has caused many embryogenists to admit the regular metameric division of the ventral mesodermic bands, and that, not only for the Crustacea, but also for the rest of the Arthropoda (excepting *Peripatus*, which appears to me to be wrongly included among the Arthropods). There is nothing in this mode of development which is comparable to the partitioning of the coelome of the Annelids and Vertebrates: the whole process stops at the development in the appendages, while they are still quite small, of clefts which are destined to become blood-lacunæ and of which the first arises almost at the centre of the limb.

The mesoderm of the body also develops in a similar way: its elements, by devouring the nutritive yolk, occasion the formation of singular spaces, which communicate with one another and develop into blood-lacunæ; one of the latter, however, surrounding the intestine, becomes isolated from its neighbours and constitutes the peri-intestinal cavity. But before this separation is effected, a group of mesodermic cells, situated above the proctodæum, elongates and acquires a central cavity, which proceeds to unite with the mesodermic spaces: this hollow mass is the rudiment of the heart.

To sum up our results. The mesoderm is produced by almost the whole of the blastoderm, without the appearance of enterocœlic rudiments or diverticula; its elements develop by the mesenchymatous process; the sole representative of a coelome is the ensemble of the circulatory apparatus and the perivisceral cavities, which has the value of a pseudocoel; no portion of it undergoes metamerization such as is met with in the Annelids or Vertebrates.—*Comptes Rendus*, tome cxiii, no. 3 (20 juillet, 1891), pp. 153-155.